3D Printing As Humanities Inquiry – NEH Start Up Grant
Directors: James W. Malazita and Dean Nieusma
End-of-Grant White Paper

Summary
This white paper provides an overview of work conducted in carrying out the NEH ODH grant, "3D Printing As Humanities Inquiry." Our funded activities entailed planning and initial experimentation with advanced 3D printing technologies; hosting a 3-day workshop on the theme of "Design as Humanities Inquiry"; and documentation and dissemination of our process, content, and findings. The workshop was attended by the project team (directors, graduate assistant, and undergraduate assistant), project advisory board members, and additional external participants.

The grant's major funded activity was the 3-day workshop, where participants followed a modified design process to deliberate, design, and reflect upon what we called a "humanities flower pot." We considered the significance of this "humanities designed" object around three key themes: 1) wear and decay; 2) function and "workingness"; and 3) replication and hybridization. Throughout the workshop, we also continually reflected upon our process and the specific influence of the goal of producing the object in directing our inquiry, considering especially the central role of learning and deploying CAD software. Following the workshop, we created a website (now in beta testing) to disseminate our process, content, and findings. We have also published some initial findings and have created a publication plan extending over the next 18 months.

After reviewing our activities, this white paper will summarize our theoretical accomplishments in terms of the grant's objectives, laying out both how we synthesized across humanities, STS, and design ways of knowing and how the project's theoretical orientation shaped our engagement with 3D printing equipment and the design tools needed to create 3D models for printing (e.g., design process, visualization techniques, CAD software, slicing software). These accomplishments are relevant to a variety of audiences, spanning the Digital Humanities, STS with its recent attention to "making and doing," and STEM fields including especially engineering. The relevance of our findings will be elaborated for each of these audiences in turn. We close the white paper by evaluating our overall achievements measured against our original goals and elaborating the project's continuation by noting the ways we have embedded lessons from the project into our institution's educational programming and making facilities.

Activities

The work plan for the project was divided into three phases: 1) Planning and experimentation; 2) Making-and-critique workshop; and 3) Documentation and dissemination.

Planning and Experimentation (May-July 2016)

This phase of the project involved background research into advanced 3D printing technologies, identification of the most-promising platforms to explore in terms of humanities inquiry, and preparatory activities leading up to the workshop, including planning of logistics (facilities, technology set-up, travel) and conceptual dimensions of the project (workshop agenda, technology training, participant roles). We hired one summer graduate researcher and one summer undergraduate researchers (supplemented by internal matching funds) to assist us with this phase and the following phase.

Design as Humanities Inquiry Workshop (23-25 June 2016)

For the primary activity funded by the grant, we ran a "Design as Humanities Inquiry" making-and-critique workshop in June 2016. This workshop explored 3D printing (and the necessary precursor of designing objects to be printed) with the goal of "materially brainstorming" printed artifacts that provide opportunities for critical investigation from the perspective of humanities modes of inquiry.

Workshop Participants

The workshop was targeted to Digital Humanities scholars specifically, but in order to achieve the intellectual and practical results of the project, participants with adjacent disciplinary expertise were also included in the event. The workshop was attended by 10 participants, including the Rensselaer research team, the grant's advisory board members (with one participating virtually), and three external participants all with expertise in 3D printing from various disciplinary perspectives intersecting with the project aims. The workshop participants are listed below along with their disciplinary training and current institutional and disciplinary affiliations.

Rensselaer Leadership Team

- James Malazita (Project Director) – PhD in Communication, Culture, & Media
    - Assistant Professor, Department of Science & Technology Studies
    - Director, Tactical Humanities Lab
- Dean Nieusma (Project Co-Director) – PhD in Science & Technology Studies
    - Associate Professor, Department of Science & Technology Studies
    - Director, Programs in Design & Innovation
- Ellen Foster (Graduate Researcher) – PhD candidate in Science & Technology Studies
- Andrea Ukleja (Undergraduate Researcher) – Programs in Design & Innovation
    - Expert in CAD applications and training

Advisory Board Participants

- Mark Sample - PhD in English
    - Associate Professor of Digital Studies
    - Director, Digital Studies, Davidson College
- Jentery Sayers - PhD in English
    - Assistant Professor of English
    - Director, Maker Lab in the Humanities, University of Victoria

External Participants

- Debbie Chachra – PhD in Materials Science
    - Associate Professor of Materials Science, Olin College of Engineering
    - Prominent public scholar on maker culture
- Daniela K. Rosner – PhD in Information Management & Systems
    - Assistant Professor, Human Centered Design & Engineering, University of Washington
    - Co-Director, Tactile and Tactical Design Lab
- Jeric Bautista – BS in Design, Innovation, & Society and Mechanical Engineering
    - Product Engineer, re:3D 3D printer startup and expert in 3D printing applications

Workshop Activities

The workshop included the following four major types of activities.

> Laying the Groundwork

- “Critical-, Translational-, Digital-: The roles and complications of design, making, and material engagement in humanities inquiry (Research team)
- Successes, trials, and tribulations of making, design, and materiality in our teaching and scholarship (All participants)
- Tutorial 1: An Introduction to 3D modeling in Rhino (Ukleja)
- Tutorial 2: The ins, outs, and foibles of 3D printing (Baustista)

> Humanities Design Workshop 1

- “A Humanistic Flowerpot?” (Group design project)
- 3D printing as “technological sublime” (informal lunch discussion/observation of the printing of the group’s designed object)
- Reflections: Was this inquiry, and if so, how? Intersections of theory-design-making
- Iterations: Successes, failures, and iteration of the Humanities Design Workshop approach

> Humanities Design Workshop 2

- Iterating the Humanities Design Workshop based on reflections and discussions
- Critical design as/for social action
- Institutional opportunities and constraints of 3D printing for the Digital Humanities

> Meta Reflections

- Assessing design process and practice in design workshops
- Next steps for the “3D Printing As Humanities Inquiry” project
- Opportunities for participant collaborations moving forward

Workshop Goals

The overarching goal of our workshop was to provide hands-on 3D printing experience to Digital Humanities scholars in order to "materially brainstorm" printed artifacts that serve as critical investigations, while also reflecting upon the broader social and environmental contexts of the 3D printing process. The intended results of this making-and-critique workshop were: 1) to produce and disseminate early-stage critical objects; 2) to generate reflexive theory and critique about 3D printing and making practices; 3) to connect humanities scholars across both the making and critical bodies of humanistic scholarship; and 4) to create an action plan for collaborative scholarship, both in writing and via making, targeted for dissemination in open-access publication platforms and exhibitions. Each of these goals was achieved as elaborated in the following sections. (See Appendix A for a full statement of the workshop's goals and participants. See Appendix B for a detailed workshop agenda.)

> Producing Critical Objects

The workshop participants produced a series of "critical design objects" as a mechanism by which to direct our making activities and to produce a concrete, mundane object that could be subjected to critical analysis and reflection. The designed object was what we ended up calling a "humanistic flowerpot." A flowerpot was chosen for a number of reasons, including its simplicity of form (which lent itself to relatively easy CAD modeling and iteration by novices); its associations as a low-tech, mundane object; that it is a boundary object in its essence; and that it fundamentally evokes relationships among people, spaces, and nature.

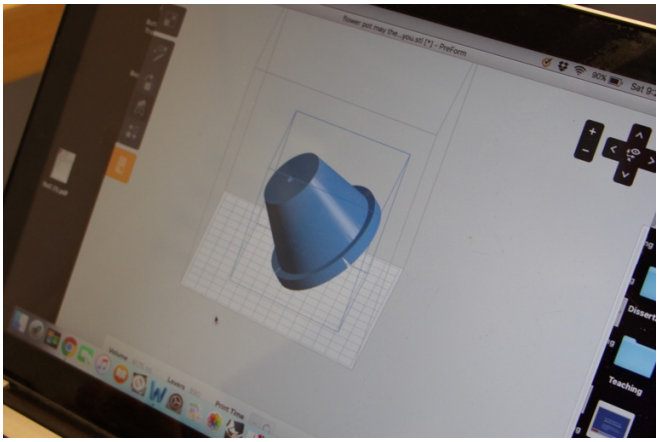

Figure 1: Humanities flowerpot in Rhino CAD

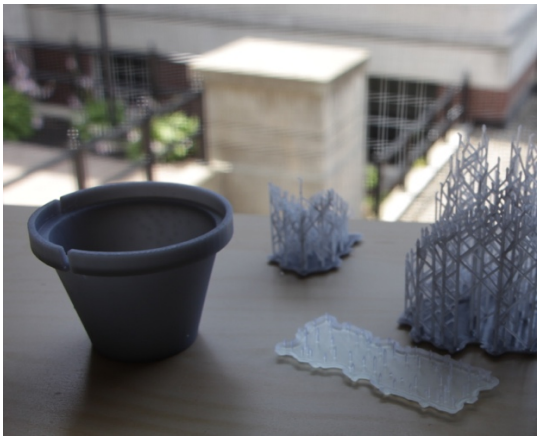

Figure 2: Humanities flowerpot 3D print

We modeled using Rhinoceros3D CAD software (Rhino). Initially, all workshop participants worked in parallel, but also collaboratively, each with their own independent "design." Since participants' CAD modeling skills were less developed than we had intended upon completion of the Rhino training sessions, our modeling process quickly devolved into a configuration in which the group of participants directed the CAD modeling activities of Ukleja, our undergraduate research assistant and Rhino expert. Once the group settled into the process of directing Ukleja's modeling activities, we seamlessly negotiated a range of features for the flowerpot that were then integrated into the original (mathematically perfect) conical frustum, a cone with its point-end cut off. The time duration of the exercise allowed us to incorporate three distinct

features that manifest our critical reflections about the CAD modeling and 3D printing processes: 1) “decay” cracks were added along the rim, 2) a drain hole was inserted through the bottom, and 3) a Star Trek badge shape was superimposed on the inside bottom.

Throughout our group design and modeling process, we reflected upon the humanities significance of the flowerpot design. Ultimately, we identified three key themes: 1) wear and decay; 2) function and “workingness”; and 3) replication and hybridization.

- Wear and decay
  One of the most provocative discussions during the modeling and fabrication of the humanistic flowerpot centered on the theme of mathematical perfection as afforded by CAD and the numerous ways imperfections, wear, and decay compromised that mathematical perfection in materialized instantiations of the CAD model. First, the 3D printing process itself introduces uncertainties and imperfections, ranging in magnitude depending on the resolution and quality of the printer; mathematical simplifications introduced by the slicing software (the software that converts the CAD file to instructions for the 3D printer); and a range of printer-specific calibrations that determine how the 3D model is oriented in space, how it is supported internally and externally, and the thickness and print quality of printed surfaces. Beyond the inevitable flaws introduced in translating from the mathematical model to a physical object, however, lay opportunities for deliberately introducing flaws as a provocation to how we thought about what made mundane objects meaningful in the realm of human experience. Not least due to the role of flowerpots in mediating between human and plant, inside and outside, household and nature, we discussed the related concepts of wear (of physical objects through use over time) and decay (of natural objects over time). To represent our engagement with the tension between mathematical perfection and a real, well-used, “worn” object, we introduced into the model two “cracks” along the upper rim of the flowerpot. The cracks were designed to appear similar to a cracked terracotta clay pot, but the cracks themselves were (in the model) mathematically perfect. Interestingly, modeling the cracks in the pot entailed considerable effort on the part of Ukleja, who had to rebuild the model from scratch more than once to get the cracks to work properly in the software. Ultimately, successfully completing the modeling of the two cracks required significantly more time than every other aspect of the design process combined. Modeling imperfection turned out to be more complicated than any of us anticipated.

Figure 3: Close-up of designed cracks in humanities flowerpot

- Function and “Workingness”
  Another designed feature of the flowerpot was the cylindrical drainage hole in the bottom to allow excess water to escape the soil. (See Figure 4.) While this feature was conceptually straightforward to add by the designers and practically straightforward to add in the CAD model, it invoked a far-ranging conversation about the “functions” of a flowerpot and what it means for a flowerpot to “work.” For example, a flowerpot works by containing soil but not excess water to enable a plant to grow within. It works by facilitating relationships of dependency and care between plant and human. It also works by containing nature in a mostly self-contained way, so humans can benefit from the presence of the plant without the messiness of soil contaminating the floors of our living spaces, thereby allowing the mediated presence of “outside” inside. And it also works by serving as an object of human exchange (e.g., gift giving) and meaning or memory making (e.g., “We got this pot on our visit to Mexico!” “Remember when that massive spider plant was just a plantlet from your father’s kitchen?”). The functions of a flowerpot that were identified during the design process also extended to include consideration a range of values (e.g., the “aesthetic function” of a pot) and users (e.g., the human users; the plant as user; microorganisms in the soil, insects, air, etc.). Here we made connections to feminist new materialism, “object-world” thinking in engineering, and other scholarly contributions that deal with intersecting agencies.

- Replication and Hybridization
  The third included feature of our humanistic flowerpot was the inclusion of a Star Trek Starfleet Insignia badge superimposed on the inside bottom of the pot. This feature was added to signal the influence of the borrowing economy associated with digital reproduction practices. Open-source and for-fee 3D printing file sharing sites, such as Thingiverse, GrabCAD, and Pinshape, have grown and proliferated rapidly along with the accessibility of 3D printers over the past decade. Consonant with the broader Maker Movement, 3D printing enthusiasts have a rich discourse around sharing, modification, and hybridization of the design work. Arguably justified in part by the character of digital reproduction, whose costs are often infinitesimal and where quality is not lost through successive reproduction, open sharing of CAD files and 3D printing instructions and

hacks are an important part of making culture and discourse. To signal that set of practices and values, we identified a suitably "techy" cultural artifact available on Thingiverse: the "Star Trek TNG [The Next Generation] Style Comm Badge."

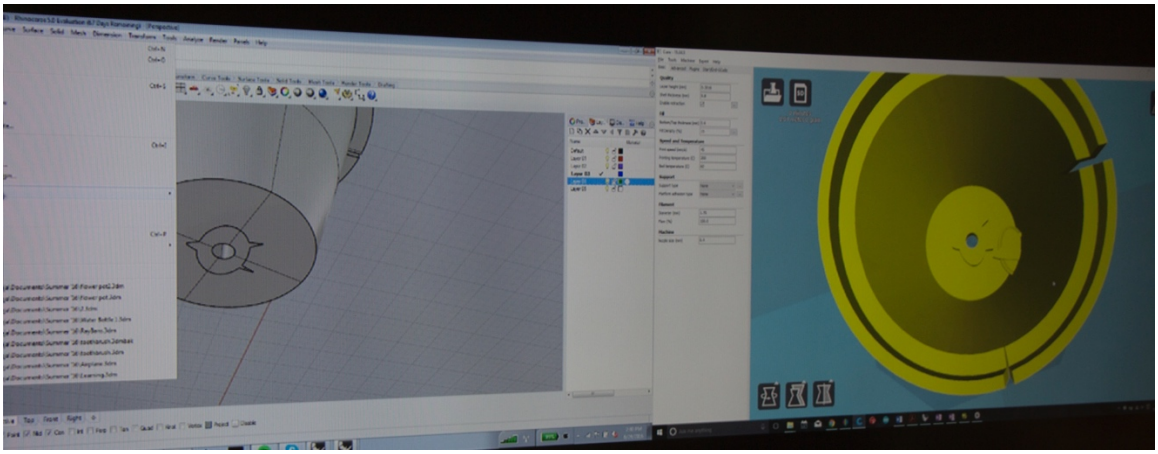

Figure 4: Star Trek badge superimposition around drainage hole in flowerpot bottom

> Reflexive Critique about Making Practices

Identifying, deliberating, and specifying the desired features of the humanistic flowerpot occupied most of the group's time during the ideation and modeling stage of our design process. During that time, there was also considerable reflection about the significance of the chosen features in terms of humanities inquiry, centering on questions of relationality, meaning making, epistemic power in the disciplines and society at large, how social/cultural/political power are embedded in artifacts and other human constructs, and especially the relationship between materiality, sociality, and making practices/design decisions. These reflections have formed the core of the scholarly publications resulting from the project thus far, so they will not be elaborated here. However, beyond reflecting on our design process in situ, we also reserved time immediately following our design activity to conduct reflexive critique, where we applied our humanities analytic lens upon making practices in the humanities in general. These conversations were directed at broadening the scope of "epistemic objects" (Knorr Cetina) considered within humanities making. Rather than delineating "humanities making" practices as the production of technological artifacts by humanists, our approach considered humanities making to be the exploration by humanists of digital phenomena more broadly.

To have the humanities take seriously the design and development of systems that do humanistic work—Digital Humanities as sociotechnical phenomena instead of Digital Humanities as produced artifacts—requires understanding material configurations, social organizations, distribution systems, programmability, technical readability, usability, accessibility, environmental impact, and manufacturing processes as fundamentally subjectable to humanistic inquiries. Such inquires cannot be divorced from the epistemic object of humanities practice, and therefore from the epistemic subjects of Digital Humanities practitioners themselves. It is thus necessary to invert Jamie "Skye" Bianco's call for a culturally and politically-situated Digital Humanities: "We are not required to choose between the philosophical, critical, cultural, and computational; we are required to integrate and to

experiment" (Bianco, 101). Rather, the philosophical, critical, cultural, and computational—as well as infrastructural, regulatory, material, and economic—are always already integrated. We must recognize that treating these aspects as not already integrated, or stripping the mundane elements away from the design process in order to more “freely” imagine alternatives, limits our capacities to analyze and intervene in sociotechnical phenomena politically.

Figure 5: Group reflexive critique of design practices and outcome

> Connecting across the Making and Critical Traditions in the Humanities

A primary meta-level goal of the workshop and the larger project was to begin to forge conceptual models and collaborative inquiry practices that successfully bridge the new attention to making in the Digital Humanities with enduring traditions extending from literary criticism and critical theory. The assembled group of participants was well suited to this task, and the centrality of the design/making process in the workshop’s formulation demanded significant attention to the many pragmatic challenges to conducting inquiry through making practice. Workshop participants noted the facility with which we managed to interweave the two approaches to inquiry, and yet the identification and assessment of the workshop’s contributions in this regard remains in rudimentary form, initiated primarily through two scholarly articles that remain in middle stages of formulation.

Our first major assessment is that, frankly, combining critical interpretation and design activities is difficult. Perhaps because of disciplinary training, it was easy for the workshop participants to bracket technical practice and interpretation, and often conversations about the two were dominated by engineering and humanities participants, respectively. Part of this was due to timing and the early-stage nature of a workshop; different participants had differing expertise, and were able to contribute more to some conversations than others. Ideally, a bridging of expertise would occur if the project lasted a longer length of time.

However, even when critical interpretations and making practices were bridged, they were often done so aesthetically. That is, the workshop was relatively successful at translating interpretive and critical language into the form of the object that could “function” as a conversation piece or

as a provocation. However, one of the strengths of design is the ability to create objects that people accept as "solutions" to problems in their everday lives, and thus to create objects that can become meaningfully integrated into larger everyday sociotechnical systems and practices. The objects developed in this workshop were clearly made by academics, in an academic setting, for academics. And though perhaps provocative, their ability to make real, material institutional change (ideally, the goal of critical theory) is admittedly limited. A future research goal would be to explore how to build critical artifacts that function in a broader array of spaces than in humanities academia.

> Collaboration Action Plan

The final goal of the workshop was to create a collaboration action plan for moving a variety of the workshop's findings into publication and considering a follow-on grant proposal to implement the inquiry on a larger scale. This dimension of the project has proven to be the most difficult to execute, but adequate progress has been made in terms of the desired implementation approach. This progress is elaborated below in the Continuation section. What remains to be done is execution of that approach along a variety of dimensions.

>> Collaborative publications

As elaborated below, we have completed and initiated several publications resulting from findings of the workshop and intersecting research and educational activities. These publications are delineated below in the Delivered Projects section.

>> Workshop series

Participants agreed that a rotating series of workshops addressing the project's core themes would be the most appropriate strategy for moving the project forward. The plan was for these workshops to be hosted by the variety of Digital Humanities making labs that have been established over the past decade, including UVictoria's MakerLab and the Digital Humanities Hill Library Makerspace at North Caroline State University. In addition to highlighting the context-specific approaches to Digital Humanities scholarship represented within each lab, the workshop series could systematically explore a range of dimensions of humanities making in a way that evolved with the growing set of findings coming out of the workshops. Implementation of this plan is contingent upon successful completion of the following collaborative activity.

>> Follow-on funding

The group decided follow-on funding was required for the rotating workshop idea to be realistic. Participants in the Troy workshop agreed in principle to collaborate on an NEH follow-on funding proposal for the workshop series, but specific tasks and responsibilities assignments have not yet been identified.

<u>Documentation and Dissemination</u> (September 2016-August 2017)

This phase of the project included compiling data gathered through the prior two phases, particularly the workshop, including participant post-workshop reflections. We have also created website content describing in detail the larger project, the workshop and its output, and the project's ongoing developments and output, including related publications. We hired

undergraduate researchers to aid in compiling data, creating the website, and disseminating our findings in other ways, such as by integrating them into related educational activities at Rensselaer.

Website

A website team was created consisting of the project directors and four undergraduate researchers (whose support was supplemented by internal matching funds). The website provides a venue for open sharing of the project's materials and results, and situates the project within the larger programmatic activities carried out by the directors, including related research, related teaching activities and programs, and resulting publications and other research and educational resources. The website remains under-development, but we have an advanced beta prototype currently operational. We have committed internal funding for undergraduate researchers to continue development of the website over the coming several semesters.

Educational Interventions

We have integrated some of the findings from the project into a range of ongoing educational research activities carried out by the project directors and hosted by Rensselaer.

- Extending from insights gained through the project, the directors have integrated humanities content into several of our design education initiatives, including course instruction in our undergraduate BS program in Design, Innovation, and Society; follow-on research proposals on the use of collaboration technologies in teaching design and CAD; and high-schooler outreach programs on design and making.
- Extending directly from the project's investments and findings related to making infrastructure, the directors leveraged the NEH grant to procure internal resources to help create a brand new "humanities makerspace" at Rensselaer. This facility, managed and funded by Rensselaer's School of Humanities, Arts, and Social Sciences, is dedicated to bridging disciplinary approaches to 3D printing, CAD modeling, and design.
- The project directors mentored one graduate student and four undergraduate students over the duration of the grant, with many additional undergraduate students participating in the project's spin-off activities, including ongoing extensions of the website.

<u>Changes and Omissions</u>

Two significant changes were made to the proposed project contrasted with the activities actually carried out. First, advisory board member Barad was forced to step down due to unforeseen obligations. We were able to recruit an additional workshop participant, Rebekah Sheldon, Assistant Professor of English at Indiana University. While Sheldon was ultimately unable to attend the workshop, we managed to bring her to campus for a follow-on, two-day making-and-critique immersion. Second, the workshop outcomes indicated the need for additional equipment to more fully explore the humanities dimension of 3D printing, namely 3D scanners. One limitation of the project as originally framed was the need for at least rudimentary CAD expertise to create content for 3D printing, which was our primary target of study. Findings from the workshop indicated that a shortcut to creating original CAD files to be 3D printed entailed the use of 3D scanners to create digital objects. As a result, we purchased 3D scanners and integrated them into the project following the summer workshop.

Publicizing of Activities

Our research activities were publicized at various stages. Rensselaer shared a news release upon original approval of the grant funding (see Appendix C). The project has been featured in several VIP tours of our institution's new "Corridor of Creativity," as a central component of our new humanities makerspace. The Corridor itself was to topic of a feature article published in our institute's internal magazine, *Inside Rensselaer*, which highlighted the project in its cover photo (see Appendix D). Grant-funded activities also led to Project Director Malazita's interview with the Chronicle of Higher Education (see Appendix E).

Accomplishments

Synthesis of Humanities, STS, and Design Ways of Knowing

One of the major goals of the grant was to experiment with how 3D printing technologies and methods could change the ways humanists and STS scholars think about and interpret making and design practice. Inversely, we were also interested in how humanities scholarship and theoretical lenses can be inflected back through 3D printing practices. As such, our grant accomplishments span from the practical and material (such as learning how to run and administer tech-heavy, hands-on humanities workshops) to the conceptual (such as deeper understandings of the epistemic frameworks that underpin both humanities scholarship and rapid manufacturing).

Theoretical Techniques for Engaging Equipment

Our initial concern with the project was simply adequately coming up to speed with the 3D printing apparatus, which spanned multiple software packages, network infrastructure, and the requirements and use of the printers themselves, as well as their accoutrement including filament, wiring, external power supply units, and post-processing tools. However, we quickly realized that learning the bricolage of material systems was not the primary challenge. Rather, the challenge was in meaningfully translating our ways of knowing—both in terms of our design knowledge and our humanities/STS analytic concepts—into the epistemic infrastructures of the 3D printing apparatus.

For example, while Malazita had extensive experience with 3D modeling software packages, most of that experience was in the domain of computer graphics (CGI) software, and not computer-aided design (CAD) software. While the interface layouts and on-screen products of each of those software paradigms look similar (both are essentially used to produce digital 3D models), the underlying goals, means, and knowledge paradigms built into CGI software was often in tension with those of the CAD software and 3D printing practice. CGI software assumes that its output—3D models and the animations and simulations that accompany them—are not intended to leave digital space. Thus, the interactions with objects generated by CGI software are assumed to be either algorithmic processes—other software packages or scripts acting upon digital objects—or the human eye viewing digital objects via a screen. CGI software therefore privileges objects "looking right" to the human eye and being calculable to other CGI platforms. As such, mathematically-calculable-yet-physically-impossible objects proliferate in CGI space.

CAD software, in contrast, presumes that designed objects are intended to be manufactured in physical space. Hence, CAD platforms design for user interactions that mirror this presumption: models must be readable by software and platforms that run manufacturing equipment (like 3D printers or digital mills). CAD platforms also tend to enable designers to assess the physically viability of designed objects that are ultimately manufactured, so these packages often include finite-element analysis scripts that calculate approximated physical stresses and strains resulting from an object's geometry, as contextualized by an object's presumed material composition (steel, plastic, etc.) and usage requirements.

The epistemic frames of CAD software tend to be better suited for 3D printing, as CAD presumes its objects are intended to be physically produced. However, the differences between these two platform paradigms were challenging to negotiate for Malazita, as the surface-level similarities between CGI and CAD software belied the deeper functional and epistemic divergences between the them. While most 3D Printing software can use models generated by CGI software, the way those models are *modeled*—how user and platform presumptions about geometry, physics, materiality, and aesthetics are mutually constituted through the 3D models—have tremendous impact on the 3D printer's capacity to materialize objects. Thus, the epistemic frames of software packages, the knowledge frameworks faculty and students were trained in, and the material realities of 3D printing interacted to influence our designed objects more than we had anticipated.

The tensions among these overlapping dimensions of design became a central analytic feature of the 3-day workshop. In addition to ensuring humanists, engineers, and designers were all represented at the design workshop, we also continuously asked our participants to reflect on the epistemic frameworks they individually brought to the design process, as well as to critique and deconstruct the frameworks that we as workshop organizers brought to the process.

We list our theoretical explorations of 3D printing in this accomplishments section, because they have led directly to our reimagining of a maker facility on campus. Through planning and articulating this institutional makerspace as a collaborative, hybrid knowledge/material production space, we secured funding and commitment by Rensselaer's School of Humanities, Arts, and Social Sciences to outfit, staff, and maintain a humanities-managed makerspace.

The lessons learned through the workshops have also led to changes in our humanities-focused design curriculum. In the year following the funded workshop, we have led an on-going series of faculty workshops to redesign our "Design, Innovation, and Society" degree program, which is a hands-on, STS-inflected, studio-centered interdisciplinary design program administered by the Department of Science & Technology Studies. These changes include more explicit incorporation of STS and Digital Humanities texts into studio work, a re-articulation of the relationships between designed objects and sociotechnical systems, and integration of more digitally-focused design activities, and they will be unrolled in stages beginning Fall 2018.

Accomplishments Compared with Objectives

Our accomplishments have largely mapped on to the objectives set forth in the grant proposal: We have organized and run an interdisciplinary design workshop, exported insights from the workshop into curricular and pedagogical material, developed a series of conceptual arguments about the relationships between humanities inquiry and material design practice, and leveraged equipment and space provided by the NEH to successfully petition our institution for investment in humanities making facilities. While we are far along in our dissemination plans—including the development of digital infrastructure to provide access to the outputs of our funded activities and the generation of research publications—we have not yet completed all those objectives.

Plans to Complete Unfinished Objectives

We have secured internal funding through Rensselaer to hire undergraduate research participants to finish curating and uploading content onto our dedicated website. We also plan to have at least four of our in-production articles under review by July 2018.

Audiences

The grant team, advisory board, and workshop participants included representation from the humanities, STS, social sciences, engineering, makerspaces, and large-scale 3D manufacturing. Partially, the disciplinary breadth of this team is a reflection of the diverse expertise represented across design and 3D printing/manufacturing. More centrally, the grant-funded activities were intended to serve as a further iteration of Rensselaer's "Translational Humanities" initiative, a set of experimental pedagogy and research activities that break down the boundaries between STEM and humanities disciplines. As such, the activities carried out were addressed to multiple audiences, both in terms of discipline (e.g., Digital Humanities, science and technology studies "Making and Doing" scholarship, humanities and STS theory, and STEM educational research) and also in terms of institutional location (e.g., faculty and graduate students, undergraduate students, and college-bound high schoolers).

Digital Humanities

The "critical making" and "speculative computing" arms of the Digital Humanities use material and digital fabrication techniques as ways of extending venues for humanities research. Generally, critical making scholars focus on the making *process*, highlighting the presence of humanists in making spaces or the embodied and material labor that takes place in those spaces. Speculative computing, in contrast, often focuses on *product*, with digital humanists constructing functional or vaporware digital products meant to serve as vehicles for interpreting and "making visible" systems of knowledge and power hidden in interfaces. While our project leverages both of these forms of inquiry, it also aims to extend them by interrogating the "problem framing" component of the design and making process.

During problem framing, designers articulate the multiple, at times incommensurable, goals of their design process, the audiences for whom those goals are important, and the spaces where

their design interventions will take place. Thus, problem framing does important epistemic, political, and material work as it establishes the assumptions upon which further design decisions will be made and justified. Often, Digital Humanities work skims over the problem framing step of the design process, choosing instead to operate at the level of material hermeneutics or production process. Such foci can often undermine the potential for reaching more diverse audiences with Digital Humanities work; when audiences are not explicitly spoken of, designers tend to re-inscribe their own experiences onto those of their presumed audiences. In the case of Digital Humanities, this may mean a process that only meaningfully operates for digital humanists themselves.

Our hope is that our activities will serve as a model for interrogating the problem framing aspect of digital fabrication, in an attempt to diversify the kinds of audiences and scholarly conversations Digital Humanities considers. This includes working to bridge Digital Humanities work with STS and STEM bodies knowledge, but also to bring creative and engineering design strengths into Digital Humanities.

STS Making and Doing

In contrast to most Digital Humanities work, the "Making and Doing" bodies of work in STS often explicitly concern themselves with matters of place, space, and audience. Making and Doing work tends to have a normative inflection, and is often cast as a way of translating normative STS theory into the "real world" producing direct material impact upon underserved communities. Making and Doing thus often manifests as ecological, data, geographical, or health justice hacking and documentation activities.

Nevertheless, the strengths of Making and Doing in terms of community material engagement can be undermined by the relative lack of attention to theoretical or interpretive dimensions of the work, the very strengths provided by a Digital Humanities lens. This missing attention often leads to narrowly defined projects that take for granted assumptions of justice, knowledge, inclusivity, and community. By using design process and hermeneutics to connect Digital Humanities work to the project directors' institutional home in STS, we hope the grant-funded activities can serve to broaden the scope of Making and Doing interventions within STS.

Engineering/STEM

Contrary to both Digital Humanities and STS Making and Doing, STEM design practices—even those that are imagined as contributing to normative or political aims—are often carried out atheoretically, in that they actively resist integrating social scientific or humanities theory into the core of their practice. When social sciences, the humanities, or the arts are addressed in STEM making spaces, they are often addressed only instrumentally, with the arts imagined merely as a utility to make STEM products more aesthetically pleasing or user friendly and the social sciences imagined as identifying the appropriate "target users" for STEM intervention. Once the process of technology design and development is underway, humanists and social scientists are often sidelined, and only occasionally brought back in towards the end of the process to serve as summative evaluators.

However, as the problem framing step of the design process highlights, STEM practitioners and their organizations make a wide variety of political, epistemic, and audience decisions even when making "purely" technical decisions. We hope this project will contribute to STEM practitioners' awareness of their interpretive power during technology design and development, and their awareness of how humanities and social scientific bodies of knowledge can be further integrated into spaces currently imagined as requiring only STEM expertise. Expanding STEM practitioners' imaginations of the importance of the humanities can have both epistemic and material impact. STEM practitioners may begin to complicate their understandings of what is and is not a part of their "core" object of concern, and they may also learn to value more highly the presence of humanities and social sciences on campus.

Evaluation

The project has been evaluated positively by all project participants, including the Advisory Board members, other workshop participants, and student researchers who participated in various components of the project. Two of our three advisory board members produced written assessments of the workshop and the project's overarching goals; insight from those assessment documents have been woven throughout the project findings elaborated above. Of special accomplishment, Advisory Board members highlighted how the workshop "organically" melded material praxis with discussion-based humanistic inquiry. Although we have not published research findings that are a direct outcome of the project, early related presentations by the research team members and publications resulting from derivative work have met with notable success, particularly from the engineering education research community of which co-directory Nieusma is a member.

Despite significant changes to the job responsibilities of both project directors (Malazita was promoted to a tenure-line appointment; Nieusma was promoted to associate dean), the funded activities have all been satisfactorily completed. The major problems that arose over the course of project have related to delays in scheduled output, most notably the project website and publications. However, significant progress has been made and continues to be made along both these dimensions, and the grant-funded project has expanded in scope considerably. The following section details the variety of continuation activities currently underway.

Continuation

<u>Activities</u>

As a Start Up grant, this project was intended to initiate a multiyear research project on knowledge generation at the intersection of humanities, 3D printing/making, and design. While the activities funded by the grant have concluded, the larger project remains ongoing. Several components of the ongoing project, with their current status, are summarized here.

"Designing DH"

An overview of the project and its major findings is being prepared for submission to the *Journal of Peer Production*, with a scheduled submission date of May 2018. This paper focuses on the

epistemological underpinnings of contemporary digital humanities makerspaces, and how they derive from an imagination of the culture of scientific laboratories. The article critiques this imagination, articulates how the humanities have their own rich "making" episteme from which to draw, and uses design methods as a vehicle for translating humanities inquiry into interdisciplinary material inquiry. The activities of the workshop are used as a case study of the strengths and constraints of the translational approach. The article is co-authored by the project director, co-director, and graduate researcher.

CAD and Making Pedagogical Research

Extending from the work of this project, the directors have commenced overlapping research into use of CAD and 3D printing as tools for bridging humanities, design, and STEM-centric making tools. This research extension has resulted in a supporting publication, "'Making' a Bridge: Critical Making as Synthesized Engineering/Humanistic Inquiry." One project on collaboration pedagogies using CAD received internal funding and resulted in a series of CAD+Design instructional modules as well as an additional publication, "From Learning to CAD to CADing to Learn: Teaching the Command, Strategic, and Epistemic Dimensions of CAD Software." Another project compares a range of different CAD platforms and how their algorithmic logics influence users' design approach and conceptualization of what design solutions are most promising. A publication resulting from this project is under development.

Construction and Critique in Digital Technology

A spin-off project by project director Malazita explores open-source logics across the fields of computer science, information technology, and arts. Also supported by the NEH ("Building a Humanities Minor: Construction and Critique in Digital Technology," NEH Division of Educational Programs), this project seeks to apply insights about translating humanities inquiry into diverse spaces, learned through the grant-sponsored activities described above, into hybrid computer science-humanities curricula. Through the first year of the 3-year grant, the project team, led by Malazita and supported by computer science and arts faculty, has developed two new classes, redesigned two additional classes, and begun rolling out a 4-course interdisciplinary pathway.

NEH Implementation Grant Proposal

The project directors have begun preliminary work on preparing a follow-on NEH Digital Humanities Implementation Grant, which aims to institutionalize the results of this Planning Grant. Partially, this institutionalization is infrastructural, organizing support for new facilities and equipment for Digital Humanities and humanities making-related initiatives. Due to the success of the Planning Grant, Rensselaer has already committed to some of these infrastructures, and they are moving forward in implementation. More importantly, the Implementation Grant will support undergraduate and graduate research activities, workshop organization, and on- and off-campus outreach.

Institutional Sustainability

Two results from the project have been elevated to permanent standing within our institution, with financial support provided by the School for Humanities, Arts, and Social Sciences under the leadership of Dean Mary Simoni.

The HASS Digital Fabrication Studio

This humanities makerspace is a direct outcome of the grant. Leveraging the project's intellectual goal of creating a uniquely humanities-inflected approach to making as well as equipment purchased for the project, the HASS Digital Fabrication Studio is now a fully operational 3D printing and digital fabrication workspace, with computer workstations, a suit of 3D printers and scanners, a laser cutter, and post-processing facilities. The lab is staffed and available to Rensselaer humanities majors 40 hours per week.

The Translational Humanities Development Initiative

In addition to informing humanities maker practices, the project's more general goal of integrating humanities inquiry with STEM-typical making equipment has been folded together with a long-term HASS development initiative, entitled the "Translational Humanities." This initiative seeks to place HASS more centrally within Rensselaer both educationally and in terms of strategic development initiatives. While not yet a funded activity, HASS has committed to providing ongoing development support for this initiative, and has spearheaded external foundation funding to underwrite the project.

Delivered Products

Workshop

The workshop was the primary "delivered product" of the grant. In addition to the production of written documents, reflections, imagery, pedagogical modules, CAD files, and 3D printed materials, the workshop was instrumental in connecting the project directors, who at the time were relatively new to the field of Digital Humanities, to other prominent scholars in the field. These connections have led to on-going collaborative efforts and advisory relationships.

Website

A web presence for Digital Humanities initiatives at RPI was established as a direct outcome of this grant: stsdesign.wp.rpi.edu. This web infrastructure was designed to enable dissemination of the goals, findings, digital content (e.g., CAD files), and publications associated with the grant, but also connects the NEH-funded initiative with the broader organizational ecosystem that the project is situated within. The site also outlines the facilities and equipment sponsored by the NEH and contextualizes the project within the directors' broader programmatic framework. The website will be made live at the end of Summer 2018.

Additional Output

1. The grant contributed directly to the preparation of a second NEH grant, which was funded via the NEH Division of Educational Programs.
2. Research from the grant led to an internal Rensselaer "Teaching and Learning Collaboratory" grant ($14,000) that applied hybridized design, 3D modeling, and humanities inquiry to the context of design and engineering education. That grant funded educational modules that will be rolled out in hybrid design-engineering classes starting Fall 2018.
3. The start-up equipment provided by the grant was leveraged in support of the creation of a humanities-administered, interdisciplinary makerspace. This led to the directors to partner with Rensselaer's Office of Educational Outreach and Summer Programming to offer humanities, design, and 3D printing workshops to high-school students during the summer. The workshops are residential, week long design and humanities immersions, and they will be offered on a continuing basis (Summer 2018 will be the third iteration of these workshops). Running these programs resulted in Rensselaer funding six additional 3D printers for our humanities makerspace.
4. The directors are currently preparing a follow-on Implementation Grant proposal for the NEH Office of Digital Humanities.
5. The grant activities have resulted directly in publications that are either forthcoming, under review, or in preparation stages. Targeted venues include the *Debates in the Digital Humanities* series, *PMLA*, *Digital Humanities Quarterly*, and *The Journal of Peer Production*, as well as conferences such as the Modern Language Association (MLA), the Association of Internet Researchers (AoIR), the Society for the Social Studies of Science (4S), the American Society for Engineering Education (ASEE), and the Society for Literature, Science, and Art (SLSA).
6. The awarding of the grant, as well as its outputs and follow-on activities, contributed to the advancement of the director from contingent faculty status to a tenure-track faculty line at Rensselaer.

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Knorr Cetina, Karin. 2001. *Epistemic Cultures: How the sciences make knowledge*. Harvard University Press.

Appendix A: Workshop Goals and Participants

Design as Humanities Inquiry Workshop
June 23-25, 2016

Hosted by the Programs in Design and Innovation (PDI), Department of Science and Technology Studies (STS), School of Humanities, Arts, and Social Sciences (HASS), Rensselaer Polytechnic Institute (RPI). Supported by the National Endowment for the Humanities (NEH).

Abstract
The medium of 3D printing has been promoted as enabling the mainstreaming of industrial fabrication. Our workshops will provide hands-on 3D printing experience to Digital Humanities scholars with the goal of "materially brainstorming" printed artifacts that serve as critical investigations, while also providing time for reflection upon the broader social and environmental contexts of the 3D printing process. The intended results of the Making and Critique workshop will be: 1) to produce and disseminate early-stage critical objects; 2) to generate reflexive theory and critique about 3D printing and making practices; 3) to connect Humanities scholars across both the making and critical bodies of humanistic scholarship; and 4) to create an action plan for collaborative written and made scholarship targeted for publication in open-access presses and exhibitions.

Participants

Rensselaer Team
Jim Malazita, Project Director and Lecturer, STS Dept.
Dean Nieusma, Co-director and Associate Professor, STS Dept., and Director, PDI
Ellen Foster, Graduate Researcher and STS PhD Candidate
Andrea Ukleja, Undergraduate Researcher and PDI student

Advisory Board
Mark Sample, Associate Professor and Director, Digital Studies, Davidson College
Jentery Sayers, Assistant Professor of English and Director, Maker Lab in the Humanities, University of Victoria
Rebekah Sheldon, Assistant Professor of English, Indiana University

External Participants
Debbie Chachra, Associate Professor of Materials Science, Olin College of Engineering
Daniela K. Rosner, Assistant Professor, Human Centered Design & Engineering, and Co-Director, Tactile and Tactical Design Lab, University of Washington
Jeric Bautista, Product Engineer, re:3D 3D printer startup

Appendix B: Design as Humanities Inquiry Workshop Agenda
June 23-25, 2016

Thursday, June 23, 2016

Morning Arrivals

3pm Introductions and Laying Groundwork
- Roundtable Introductions
- "Critical-, Translational-, Digital-: The roles and complications of design, making, and material engagement in humanities inquiry" – *Jim Malazita, Dean Nieusma, Ellen Foster*

5pm Working Dinner @ The Next Level at the Ruck
- Successes, trials, and tribulations of making, design, and materiality in our experiences as scholars and teachers

8pm Adjourn for day

Friday, June 24, 2016

8am Hotel pick up, Settling in, coffee, light breakfast

9am Tutorials
- An Introduction to 3D modeling in Rhino, *Andrea Ukleja*
- The ins, outs, and foibles of 3D printing, *Jeric Baustista*

11pm Humanities Design Workshop 1
- "A Humanistic Flowerpot?" Group design project
- Lunch, the technological sublime of the 3D printer

1pm Reflections and Iterations
- Was this inquiry? Theory-design-making reflections
- Successes, failures, and iteration of the Humanities Design Workshop

3pm Humanities Design Workshop 2
- Applied iterations, design, and making from reflection

5pm Break, return to hotel, unwind

6pm Dinner and further reflections at The Shop
- Critical design as/for social action
- Institutional opportunities/constraints for Digital Humanities

8pm Drinks with open invitation to STS Department members

Saturday, June 25, 2016

8am Hotel pick up, coffee, light breakfast

9am Assess Friday's design process and practices

10am Next steps for the Startup Grant

10:30 Planning for the Implementation Grant proposal

11am Opportunities for participant collaborations

12pm Lunch on site and transitions

1pm Unstructured research and planning with remaining participants

5pm Dinner near airport

Appendix C: Rensselaer News Release

STS Faculty Win NEH Grant to Explore Role of 3D Printing in Digital Humanities Research

Date posted: 2016-03-24 11:34:59

A National Endowment for the Humanities (NEH) Start Up Grant was awarded to James Malazita and Dean Nieusma, faculty in the Science and Technology Studies Department of Rensselaer's School of Humanities, Arts, and Social Sciences (HASS).

As a componert of HASS's broader Translational Humanities initiative, the grant project seeks to enhance education and research within the Digital Humanities by bridging the critical, theoretical strengths of humanities inquiry with the creative, embodied material practices involved in 3D printing. Malazita and Nieusma's project entails a series of explorations in 3D printing within the domain of "critical making," which connects hands-on material making activities with broader concerns. To this end, the grant will support a Critical Making workshop to be held at Rensselaer in the summer of this year, which will include participation of leading scholars in Digital Humanities research.

One goal of the project is to use current enthusiasm around 3D printing and makerspaces as a vehicle for thinking through the social and environmental dimensions of material innovation. More ambitiously, the grant seeks to lay the groundwork for a larger project exploring material innovation practices as a window into the nuanced, complex, and non-determinist ways in which technology and society interact.

The award was announced by the NEH yesterday as part of $21.1 million in new awards (see NEH press release here). For additional information on HASS's Translational Humanities initiative, see the project brochure (available for download as a PDF file here).

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Questions and comments.
School of Humanities, Arts and Social Sciences

Rensselaer

Appendix D: Rensselaer's Corridor of Creativity Feature Article

INSIDE Rensselaer

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Corridor of Creativity Provides Windows Into HASS

Re-imagined hallway offers glimpse at creative process, projects

NOVEMBER 16, 2017

1 2 3 4 5 6

The School of Humanities, Arts, and Social Sciences (HASS) has transformed two cinderblock hallways of the Sage Labs into the Corridor of Creativity, a place where visitors can view the latest student projects and catch a glimpse of innovation in action.

Posters, sketches, and other artwork now grace the walls on the first and second floors of Sage Labs. Sculptures occupy strategic spaces, and postings on the "Wall of Opportunity" invite students to collaborate on startups and other ventures. Once-solid walls now include large windows that compel passersby to pause to watch inventors, animators, and designers at work in studios, classrooms, and labs.

For HASS Dean Mary Simoni, one of the most important results of the redesigned space is the interaction it fosters among students from different disciplines.

"Any student can use any space—woodworking shop, 3-D printing lab, game development studios," she said. "Now, students in science and technology are working side by side with students in sculpture, building a community around creation and discovery. That's a beautiful thing."

The Corridor of Creativity has become part of every admissions tour to introduce parents and prospective students to a lesser-known side of Rensselaer. October visitors—including those on campus for Reunion & Homecoming 2017—saw exhibits from classes including *Basic Drawing*, *Intermediate Drawing*, *Typography*, *Visual Literacy*, and *Design for Global Society*.

One poster promoted the Art_X Symposium of Music, Sound, and Mathematics at Rensselaer. Another poster presented "3-D Printing As Humanistic Inquiry," research led by HASS Assistant Professor James Malazita and Associate Professor Dean Nieusma. The project is funded with a grant from the National Endowment of the Humanities. Still another exhibit paid tribute to the late Pauline Oliveros, distinguished research professor of music at Rensselaer and founder of the practice of "deep listening."

The story behind the corridor is quintessentially Rensselaer. It begins with a student who came to Simoni concerned about the lack of space to display posters and other artwork to support the academic program. Simoni knew other students shared that concern. She also knew that there simply weren't enough resources to provide separate space for every program.

Simoni saw a chance not only to turn a problem into an opportunity but also to reinforce what she considers "a philosophical imperative." She was determined to find a place where students could showcase their accomplishments while benefiting from each other's differing perspectives.

The solution came to her one morning, during her usual walk from West Lot to her office in Sage Labs. As she passed the cinderblock walls on the first and second floors, Simoni's thoughts turned to the activity those walls were hiding. "There was so much going on behind them," she said. "If we could blast through some of those walls and install glass, we could see into the studios."

From that germ of an idea came a renovation that also provided exhibit space and—with a $500,000 grant from the Lemelson Foundation—established the state-of-the-art Burt Swersy Inventors Studio.

"It became a multiyear facilities renovation plan to update, repurpose where necessary, and create more interconnectivity in the entire corner of those two levels of the building," Nieusma said. "Behind all that cinderblock, highly engaged, interactive design work was going on. We made that work visible.

"We took an underutilized space and revitalized it," he added. "Instead of plain cinderblock hallways, we have cinderblock halls punctuated with points of excitement, energy, and creativity."

POSTED IN: ACADEMICS

Appendix E: Project Director Jim Malazita's *Chronicle of Higher Education* Interview

(To follow)

THE CHRONICLE
of Higher Education

FACULTY

Can Higher Education Make Silicon Valley More Ethical?

By Nell Gluckman | MARCH 14, 2018

The internet and the technology companies powering it have shown their dark side recently. Racism and sexism have flourished, mostly unchecked, on social media. Algorithms used by Facebook and Twitter have been blamed for the spread of fake news. And as phones, cars, and household devices scoop up their users' data, the expectation of privacy has practically evaporated.

Under each of those phenomena lie ethical quandaries. Is technological development outpacing our ability to tease out its implications? If so, is higher education responsible for the problem?

Rensselaer Polytechnic Institute

Jim Malazita, an assistant professor at Rensselaer Polytechnic Institute, hopes to infuse ethics lessons into core computer-science courses.

Jim Malazita, an assistant professor of science and technology studies at Rensselaer Polytechnic Institute, believes higher education has played a role. He thinks there's something about how the STEM disciplines are taught — science, technology, engineering, and mathematics — that discourages students from considering ethical questions as they learn the skills they need to work for big technology companies. But if colleges and universities are contributing to the problem, then they can also help fix it.

With funding from the National Endowment for the Humanities, Malazita is piloting an initiative to inject discussions of ethics and politics into introductory computer-science courses at Rensselaer, in New York. He is pushing back against the idea that programmers should focus purely on technical work and leave the softer questions about how their products are used to social scientists. He hopes his students will see it as their job to build socially responsible technology.

He spoke to *The Chronicle* about his course and the history of ethics in STEM education. The interview has been edited for clarity and length.

Q. How is what you're trying to do different from the way ethics and computer science are usually taught?

A. Rarely will you talk to a STEM student who says ethics aren't important. But by the time they're done with their education, they're like, It's other people around me's job to make sure this technology is doing the right thing.

Rather than pairing computer science with a suite of courses to make computer science ethical, what if we get humanists into core computer-science classes to get students to think about the ethics and politics of computer science as part of their core skill set?

How can we teach you Python and coding, but at the same time always talk about coding as a political practice?

Q. What will that look like in your course?

A. We're using data sets about various social issues, such as race and violence in New York City, and a Unesco database about education funding. We're saying, Here are these data sets you're going to have to crunch through using Python. What do these algorithms leave out? What can't you account for?

We're thinking through teaching how to use code and the way the code shapes the way you think about the database. Every language you learn has a bias to it, so let's acknowledge that.

Q. What's an example of a type of problem you might have your students solve that helps them understand their work as programmers more politically?

A. The data set about gun violence in New York City is already used by computer-science faculty in the classroom. But the way the problems are framed is: Walk through the data set, parse up where gun violence is and where it's not. And then based on those findings, tell me where you would rather live and rather not live in New York City.

We use the data set, but with readings about gun violence. We ask what's the problem with asking the question in this way. How can we use this data to understand the phenomenon of gun violence rather than "these parts of New York City are good and these parts are bad"?

Q. You mentioned you've been getting some pushback.

A. I've had to do a lot of social work with computer-science faculty. The faculty were like, This sounds cool, but will they still be able to move on in computer science? We're using different, messier data sets. Will they still understand the formal aspects of computing?

Q. What do you tell faculty members to convince them that this is a good use of your students' time?

A. I use a couple of strategies that sometimes work, sometimes don't. It's surprisingly important to talk about my own technical expertise. I only moved into social science and humanities as a Ph.D. student. As an undergraduate, my degree was in digital media design. So you can trust me with this content.

It's helpful to also cast it in terms of helping women and underrepresented-minority retention in computer science. These questions have an impact on all students, but especially women and underrepresented minorities who are used to having their voices marginalized. The faculty want those numbers up.

Q. Is there a precedent for teaching ethics as part of STEM education?

A. In early computational education, businesses asked the instructors of engineering and STEM classes to teach philosophy in their classes. They thought if they learn philosophy, they'll be better able to market products, understand what people need.

They read the same texts as humanities students — Plato, Hobbes, Locke — but they would read them differently. The thinking was, Now that I've read Plato, I know how people work, and I can create systems that take advantage of how people work.

By the 1960s, during the Vietnam era, there was a pushback against technology. You start seeing these movements of new engineers who say, Hey, we need to teach things like technology and society. This is part of a newer generation of writings. Rachel Carson's work is an example.

In the 1970s, there was a huge backlash from deans who said, You're diluting the core of engineering. Students are starting to become less-efficient employees. We need to reconstruct engineering education. It's not their role to make sure it has positive impact. That's the role of their managers.

Q. What do you hope your students will do with what you're teaching them?

A. I tell my students, I'm not training you for your first job, I'm training you for your second job. Chances are their entry-level job will want them to not think about social issues and will want them to just be programmers.

But once they move into design, that's wide open for them to bring back in this knowledge.

If my students get a second job at Facebook, I want our students to go in and say how is Facebook working from a technological perspective and how are those technology issues framing the social issues and discussions that get posted on Facebook.

Nell Gluckman writes about faculty issues and other topics in higher education. You can follow her on Twitter @nellgluckman, or email her at nell.gluckman@chronicle.com.